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Governor

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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M E M O R A N D U M

March 18, 1981

To: Carl Nuechterlein

From: Bill Yake BY

Subject: Walla Walla Class II Inspection

Introduction

A Class II inspection was conducted on February 3-4, 1981 at the Walla Walla sewage treatment plant (STP). Department of Ecology (DOE) personnel involved in the facility inspection were Marc Heffner and Bill Yake (Water and Wastewater Monitoring) and Carl Nuechterlein and Larry Peterson (Eastern Regional Office). The City of Walla Walla was represented by lead operator Al Prouty and Earl Anderson.

A survey of the receiving stream (Mill Creek) was conducted simultaneously by Lynn Singleton and Joseph Joy (Water and Wastewater Monitoring). The results of the stream survey will be reported in a separate document.

Setting

Wastewater treatment in Walla Walla consists of two major facilities: the treatment plant and a large spray irrigation field. Summertime wastewater flows from major food processing industries are pumped directly to the irrigation project while the wastewater treatment plant primarily serves to process domestic waste. During the summer irrigation period (approximately the middle of April to the middle of October), treated effluent is diverted to two irrigation districts (Blalock and Gose). During the remainder of the year, treated effluent is discharged to Mill Creek.

Mill Creek (surface water segment 15-34-04) is an artificially intermittent stream. Upstream irrigation withdrawals result in little or no flow in the lower creek during much of the irrigation season. In the 1980 Water Quality Index (WQI) analysis of surface water segments in Washington State, Lynn Singleton reported an overall WQI of 41.1 for Mill Creek, giving Mill Creek the 8th highest WQI in the state. Mill Creek is a tributary to the Walla Walla River which received an overall WQI of 51.3, giving it the number three ranking in the state. A more detailed summary of WQI's for these segments is displayed in Table 1:

Table 1. Water Quality Index Data for Mill Creek and the Walla Walla River.

Segment Number	Station Number	Temp.	Oxygen	pH	Bact.	Trophic	Aesth.	Susp. Solids	Ammonia Toxicity	Overall
15-34-04	Mill Creek and Tribs.									
	$\bar{X}$	33.0	16.2	15.6	20.7	41.7	15.6	*	11.0	41.1
	32C070 (H)	45.5	20.7	20.7	24.7	56.3	14.3	*	16.1	62.3
	32C110 (H)	15.8	10.0	8.5	15.3	21.6	17.3	*	3.9	12.0
15-34-02	32A070	51.0	16.6	9.0	21.5	39.4	43.3	(69.2)	11.7	51.3

(H) = Historical data
* = Insufficient data

The degree to which the Walla Walla plant contributes to these water quality problems is somewhat problematical as the Mill Creek WQI is based on historical data and the worst three months (upon which the WQI is based) are July, August, and September -- a period during which the plant does not discharge to Mill Creek.

The effect of the discharge on surface waters will be fully addressed in the receiving water report.

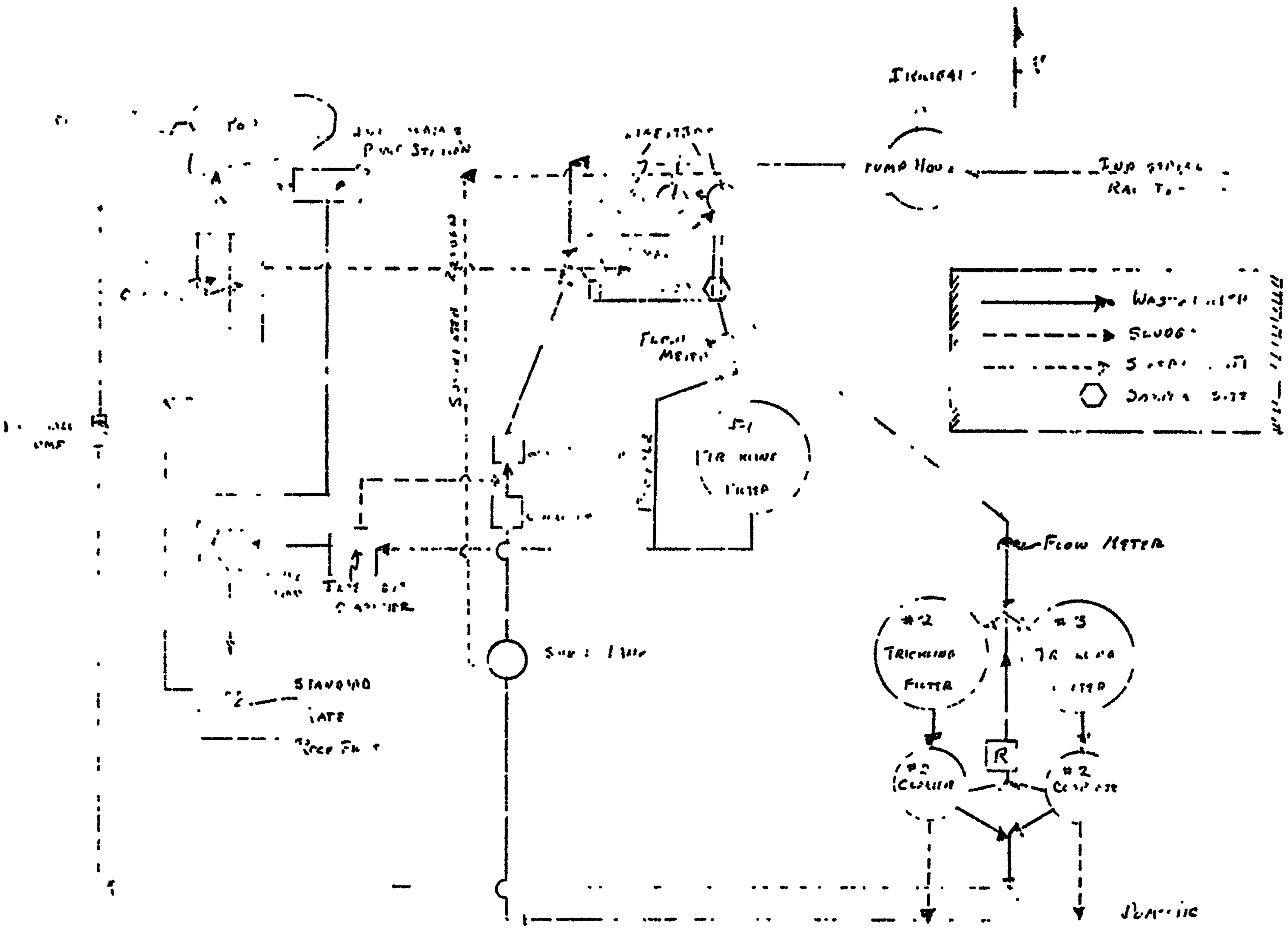
The Walla Walla wastewater treatment plant provides secondary treatment by way of an unusual and somewhat complicated flow scheme as depicted in Figure 1. The basic sequence is: primary clarifier; trickling filters; intermediate clarifiers; fixed-nozzle, rock bed filter; final clarifier; and chlorination followed by discharge. Several features require special note:

1 There is no available location for obtaining a representative sample of plant influent prior to underflow (sludge) return from the intermediate and final clarifiers to the primary clarifier.

2. Primary clarifier effluent is split: a portion routed to the #1 trickling filter; another portion to the #2 and #3 trickling filters.

   (a) Plant flow meters are placed in these lines. These meters record flows which include the underflow returns from the intermediate and final clarifiers. Thus they overestimate plant influent.

WALLA WALLA WASTEWATER TREATMENT PLANT



(b) The distributor arm on the #1 trickling filter is defective and requires approximately 60 percent of the total plant flow to turn it. The #1 trickling filter is therefore heavily loaded with respect to the #2 and #3 trickling filters.

The existing plant is slated for an upgrade and design work is approaching completion. Major alterations presently planned by the city's consultant (CH_2M-Hill) are:

1 A new headworks with flow measuring device prior to any sludge return

2. Series operation of the trickling filters with all flow passing through the #1 trickling filter, then split to the #2 and #3 filters.

3. Discontinuation of the fixed-nozzle standard rate rock filter.

4. Sand filtration.

5. Redesign of the contact chamber.

Results and Discussion

Sampling time and location information is summarized in Table 2, while analytical results are displayed in Table 3. Table 4 summarizes compliance during the inspection.

Based on DOE analyses, the plant was within permit limits for all parameters except fecal coliform. The proposed permit places a new limit on total chlorine residual (TCR) of less than 0.5 mg/L. For this reason plant personnel were asked to decrease their residual to ascertain the ability of the present plant to simultaneously meet the new TCR requirement and the fecal coliform limitation. Previously, the plant had operated a residuals from 0.8 to 1.5 mg/l and had easily met fecal coliform requirements. The results of the bacterial samples collected during this inspection indicate that until the design of the contact chamber is improved, compliance with the fecal coliform limit may be marginal if chlorine residuals are maintained at less than 0.5 mg/l.

The plant was operating very efficiently with respect to suspended solids and BOD removal. Eighty-five percent removal was being achieved despite low wastewater temperatures and continuing problems with the #1 trickling filter distributor arm which requires greater than 60 percent of the total flow to be routed to this filter.

The results of the BOD test deserve particular scrutiny. Total BOD_5 tests were run by both the DOE and the STP laboratories. In addition, long-term, multiple-day total and carbonaceous BOD tests were performed on the final effluent by the DOE laboratory. The results are given in Table 5.

Table 2 24-hour Composite Sampler Installations.

Sampler	Date and Time Installed	Location
Influent - Grab Composite		Immediately downstream from comminutor
Primary Influent 220 mls/30 min.	2/3/81 - 0900	At T in primary clarifier influent channel
Primary Effluent 230 mls/30 min.	2/3/81 - 0910	Primary clarifier outlet channel to #2 and #3 trickling filters
Dosing Siphon Influent 220 mls/30 min.	2/3/81 - 0935	Influent spill box from #2 and #3 trickling filter effluent to dosing siphon
Final Effluent 220 mls/30 min.	2/3/81 - 1010	Downstream from final clarifier in concrete channel immediately prior to final effluent pipe

Field Data

Parameter(s)	Date and Time	Sample Location
pH, Sp. Cond., Temp	2/3/81 - 0900	Primary Influent
pH, Sp. Cond., Temp	2/4/81 - 0913	Primary Influent
pH, Sp. Cond., Temp	2/3/81 - 0910	Primary Effluent
pH, Sp. Cond., Temp	2/4/81 - 0925	Primary Effluent
pH, Sp. Cond., Temp	2/3/81 - 0935	Dosing Siphon Influent
pH, Sp. Cond., Temp	2/4/81 - 1000	Dosing Siphon Influent
pH, Sp. Cond., Temp., Tot. Chl. Resid.	2/3/81 - 1010	Final Effluent
pH, Sp. Cond., Temp., Tot. Chl. Resid.	2/4/81 - 1045	Final Effluent
Total Chl. Resid.	2/4/81 - 0945	Final Effluent
Total Chl. Resid.	2/4/81 - 1125	Final Effluent

Grab Samples

Lab Analysis	Date and Time	Sample Location
Fecal Coliform	2/4/81 - 0945	Final Effluent
Fecal Coliform	2/4/81 - 1125	Final Effluent

Table 3. DOE Laboratory/Field Results.

Parameter	Influent (grab composite)	Primary Influent	Primary Effluent	Dosing Siphon Influent	Chlorinated Effluent	Expired Monthly Permit Limitations
Flow (MGD)	(6.9)	(6.9)	(6.9)		(6.9)	9.12
Carbonaceous BOD5 (mg/l) (lbs/day)					8 460	
Total BOD5 (mg/l) (lbs/day)	88 5060	83 5060	82 4720	18	11 630	12 770
TSS (mg/l) (lbs/day)	121 6920	105 6040	45 2590	13	11 630	16 1022
Fecal Coliform (#/100 ml)					545^1 260^2	200
Total Chlor. Res. (mg/l)					$.45^1$ $.45^2$	$.5^{\dagger}$
Temp. (°C)		13.2 13.2	12.5 12.6	10.6 10.6	10.3 10.4	
pH (S.U.)	6.8	7.5 7.2* 7.0* 7.2**	7.4 7.2* 7.0* 7.1**	7.7 7.3* 7.2* 7.5**	7.5 7.3* 8.2* 7.4**	
Spec. Cond. (μmhos/cm)		303 320* 335* 321**	283 292* 298* 310**	263 235* 267* 296**	265 223* 250* 290**	
Turbidity (NTU)		56	27	8	10	
NH_3-N (mg/l)		7.3	7.8	5.05	3.6	
NO_2-N (mg/l)		<.1	.3	.1	<.05	
NO_3-N (mg/l)		.6	.7	3.25	5.35	
O-PO_4-P (mg/l)		2.3	1.8	2.05	2.45	
T-PO_4-P (mg/l)		4.0	3.6	3.15	3.10	
Total Solids (mg/l)		320	245	201	218	
TVS (mg/l)		174	144	126	140	
TSS (mg/l)	121	105	45	13	11	
TNVSS (mg/l)		28	4	2	2	
Cd (mg/l)		<.01		<.01		
Cr (mg/l)		<.02		<.02		
Cu (mg/l)		.04		.01		
Ni (mg/l)		<.03		<.03		
Pb (mg/l)		.022		.0038		
Zn (mg/l)		.59		.10		
Fe (mg/l)		1.2		.22		
Hg (mg/l)		.02		.02		

† - Proposed limitation
* - Field analysis, grab sample
** - Field analysis, composite sample

Table 4. Walla Walla STP Compliance.

Parameter	DOE Samples DOE Analysis	DOE Samples STP Analysis	STP Samples STP Analysis	Lapsed Permit		Proposed Permit*	
				Weekly Avg.	Monthly Avg.	Weekly Avg.	Monthly Avg.
Flow (MGD)	(6.9)	(6.9)	(6.9)	--	9.12	--	9.12
Total BOD_5 (mg/l)	11	19	--	24	12	45	30
(lbs/day)	630	1090	--	1641	770	2282	3423
% Removal	87.5%	78.9%	--	--	85%	--	85%
Carbonaceous BOD_5 (mg/l)	8	--	--	--	--	--	--
(lbs/day)	460	--	--	--	--	--	--
% Removal	90.9%	--	--	--	--	--	--
TSS (mg/l)	11	--	14	32	16	45	30
(lbs/day)	630	--	810	2178	1022	2282	3423
% Removal	89.5%	--	86.5%	--	85%	--	85%
Fecal Coliforms (#/100 ml)	545	--	--	400	200	400	200
	260	--	--	400	200	400	200
Total Chlorine Residual	.45	--	--	--	--	<0.5	<0.5
(mg/l)	.45	--	--	--	--	<0.5	<0.5

* - During periods of discharge to Mill Creek

Table 4a. Sludge Metals Results.

Metal	Concentrations (mg/kg dry weight)
Cd	8.4
Cr	170
Cu	470
Fe	19,200
Ni	34
Mn	220
Pb	390
Zn	1,540

Table 5. Results of Effluent BOD Test.

Time (days)	Carbonaceous BOD (mg/L)	Total BOD (mg/L)
4	7	10.4
5	8	11
8	11	15
12	14.5	21
15	16	31
0	19	50

In addition, the results of the carbonaceous (nitrification inhibited) tests are graphed in Figure 2.

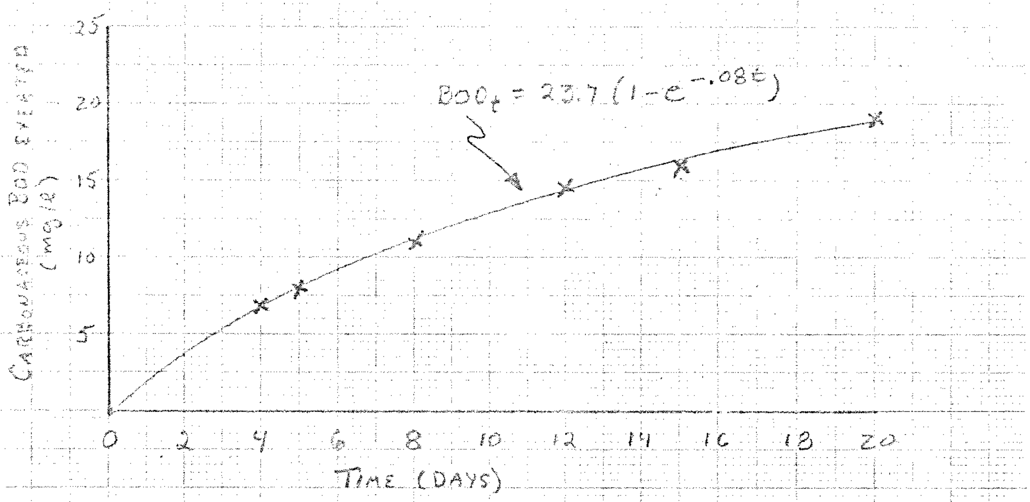


Figure 2 Effluent BOD, Walla Walla STP

The best fit first order equation for effluent BOD satisfaction was:

Equation 1 $BOD_t = 23.7\ (1-e^{-.08t})$

where BOD_t = BOD satisfied at time t

t = time in days

The excellent fit of these data gives us high confidence in the accuracy of this test. The discrepancy between the five-day carbonaceous BOD (8 mg/L) and the total BOD_5 determined by the DOE lab (11 mg/L) and the STP lab (19 mg/l) is a cause for concern. This is particularly true because the STP results indicate a permit violation: i.e., only 78.9 percent BOD removal. The NH_3-N present in the effluent (3.5 mg/L) could result in an oxygen demand of about 17 mg/L. The ammonium chloride added to the BOD dilution water could increase this discrepancy. It is very possible that a major reason for the plant's occasional inability to meet the 85 percent BOD removal limitation is nitrification in the effluent BOD test.

Although traditionally the five-day BOD test concludes before nitrification begins due to the slow growth rate of nitrifiers, certain water samples, including effluents from partially nitrifying treatment plants, contain high enough populations of nitrifiers to begin oxidation of ammonia early in the test. Thus plants achieving partial nitrification are in fact penalized. It is our position that in such situations, inhibition of the final effluent sample be allowed. If nitrogenous oxygen demand or ammonia toxicity in the receiving water is a concern, a separate ammonia limitation should be included in the permit. This approach is preferable to basing compliance on total BOD because this test is a poor indicator of in-stream nitrification. The receiving water report will address this question in more detail

During the inspection the plant flow meters were checked for accuracy and substantial discrepancies were found. Instantaneous flows were taken in the influent channel to the primary clarifier, pond effluent channel, and at the discharge pipe. These flows are compared in Table 6 to the total flows recorded on the plant's in-line Sparling flow meters:

Table 6. Flow Measurement.

	Plant Meters	Influent Channel	Effluent Channel	Discharge Pipe
Flow MGD	8.7	7.62	7.13	6.58
	8.9	7.81	6.94	

An attempt was made to use the old Parshall flume in the line from the #2 and #3 clarifiers to the pump house to determine the accuracy of the Sparling meter prior to the #2 and #3 trickling filters. After opening the bypass valve to allow free flow in the Parshall flume, a concrete block was found in the flume throat. Plant personnel indicated the block had been placed in the flume years ago to make the flume measurement match the Sparling flow meter. Plant personnel later replaced this Sparling meter with the meter which had been in line to the sewage farm. The block in the flume also was removed and the two devices checked for accuracy by CH_2M-Hill personnel. It was determined that the old meter had been reading approximately 1 to 1.5 MGD too high.

Another source of flow measurement error is due to the fact that the Sparling meters are located downstream of the sludge return flow from the intermediate and final clarifiers. Plant personnel checked pump sizes on these returns and indicated that the total sludge return flow was about 520 GPM or .75 MGD. Thus, even if the Sparling meters were accurate, they would overestimate actual influent flow by about .75 MGD Using this information, 24-hour flow obtained from the plant totalizers (8.42 MGD) was decreased to 6.9 MGD for the purposes of this report.

The extent to which erroneous flow data have been used in the design for plant upgrade should be addressed and modifications made as necessary Ed O'Brien (Construction Grants) has indicated he will be contacting CH_2M-Hill to resolve these questions.

Sample Collection and Laboratory Procedures

Sample collection and laboratory procedures were reviewed with Al Prouty and Earl Anderson. Techniques were, in general, excellent. Several recommendations were made concerning modifications in procedures and some of these have already been implemented. Analyses performed on samples split between the DOE and STP laboratories compared favorably in most cases as shown in Table 7.

Table 7. Comparison of Analytical Results: DOE and STP Laboratories.

	BOD_5 (mg/L)		TSS (mg/L)	
	DOE Sample DOE Analysis	DOE Sample STP Analysis	DOE Sample DOE Analysis	STP Sample STP Analysis
Primary Clarifier Influent	88	90	105	104
Primary Clarifier Effluent	82	67	45	30
Int. Clar. Eff.				15
Dosing Siphon	18	17	13	13
Final Effluent	11	19	11	14

Points raised during the review are noted below:

Sampling

(1) The influent sampling locations are biased by sludge returns from the intermediate and final clarifier sludge return. With

the present flow scheme there is no adequate solution to this problem. After upgrade, a satisfactory influent sampling location should be available at the new headworks.

BOD_5

(1) Suggest use of liter dilution method. This has been implemented.

(2) Modify calculation procedures to always use the zero-day sample dilution method as the beginning point for calculations. This has been implemented.

(3) To calibrate the incubator, use a water bath thermometer in the incubator. Maintain and post a log of incubator settings and temperatures.

(4) Standardize sodium thiosulfate at the time that it is made up.

(5) Routinely check pH of BOD samples (particularly industrial samples) and adjust sample pH to 6.5 to 8.5 as necessary. See below.

pH

(1) Calibrate pH meter daily when in use. Use at least 2 buffers in calibration. Note that temperature adjustment is calibrated in °C.

Suspended Solids

(1) Convert to using approved filters (Reeves Angel 934AH or Gelman A/E)

Conclusions and Recommendations

1. The Walla Walla STP was meeting BOD and TSS permit limitations during the inspection. The plant was operating very efficiently with respect to suspended solids and BOD removal.

2. The plant may have some diffulty simultaneously meeting both the fecal coliform limitation and the proposed residual chlorine residual limitation. Improvements in contract chamber design should result in simultaneous compliance. In the interim, you may wish to slightly modify the requirements after reviewing several months of flow, chlorine residual, and fecal coliform data.

3. Discrepancies were noted in plant flow measurement. The inaccuracy of the #2 and #3 trickling filter Sparling flow meter appears to have been remedied. The overmeasurement of flow due to the [illegible] meter location (in the middle of the sludge return loop) has not been remedied. The extent to which incorrect flow data may have been incorporated into the plant upgrade design should be addressed by the Municipal Grants Division and CH_2M-Hill.

4. Upgrade design should (and apparently will) provide for flow measurement outside the sludge return loop and an influent sampling location which is unbiased by sludge and supernatant return.

5. As noted before, the collection system is apparently plagued by a great deal of infiltration and/or inflow.

WEY:cp

Attachments

LABORATORY PROCEDURAL SURVEY

Discharger: [illegible] TP

NPDES Permit Number: [illegible]

Date: [illegible] 21/[illegible]

Industrial/Municipal Representatives Present: [illegible]

Agency Representatives Present: Bill Yake, Marc Heffner

I. COMPOSITE SAMPLES

A. Collection and Handling

1. Are samples collected via automatic or manual compositing method? Manual, Model?

   a. If automatic, are samples portable N/A or permanently installed N/A?

   Comments/problems Equal samples collected at 3 hr. intervals: 0900, 1200, 1500, 1800, 2100, 2400, 0300, 0600

2. What is the frequency of collecting composite samples?

   Composite samples are analyzed for BOD & TSS twice weekly

3. Are composites collected at a location where homogeneous conditions exist?

   a. Influent? Solids return upstream of sampler w/ no present solution

   b. Final Effluent? OK (Final Clarifier)

   c. Other (specify)? OK (1° Clarifier Eff, Trick. Filter Eff, #2 & #3 T.F. Effluent)

4. What is the time span for compositing period? 24 hr.

   Sample aliquot? 235 mls per 3 hrs ~~minutes~~

5. Is composite sample flow or time proportional? Time

6. Is final effluent composite collected from a chlorinated or non-chlorinated source? [illegible]

7. Are composites refrigerated during collection? Yes

8. How long are samples held prior to analyses? [illegible]

[illegible]

9. Under what condition are samples held prior to analyses?

   a. Refrigeration? X

   b. Frozen? __________

   c. Other (specify)? __________

10. What is the approximate sample temperature at the time of analysis? [illegible]

11. Are compositor bottles and sampling lines cleaned periodically? [illegible]

    a. Frequency? __________

    b. Method? __________

12. Does compositor have a flushing cycle? N/A

    a. Before drawing sample? __________

    b. After drawing sample? __________

13. Is composite sample thoroughly mixed immediately prior to withdrawing sample? Yes

Recommendations:

1) [illegible] COMPOSITE SAMPLERS [illegible]

[illegible]

2) [illegible]

[illegible]

3) [illegible]

[illegible]

II. BIOCHEMICAL OXYGEN DEMAND CHECKLIST

A. Technique

1. What analysis technique is utilized in determining BOD_5?

   a. Standard Methods? X Edition? [illegible]

   b. EPA? ______

   c. A.S.T.M.? ______

   d. Other (specify)? Also Have Copy of Our Procedures

B. Seed Material

1. Is seed material used in determining BOD? Yes for Industrial [illegible] Post Final Effluent.

2. Where is seed material obtained? Primary Effluent

3. How long is a batch of seed kept? Not Used

   and under what conditions? (temperature, dark) N/A

4. How is seed material prepared for use in the BOD test? None

Recommendations:

OK

C. Reagent Water

1. Reagent water utilized in preparing diultion water is:

   a. Distilled? [illegible]

   b. Deionized? ____________

   c. Tap ____________, chlorinated ____________ non-chlorinated ____________

   d. Other (specify)? ____________

2. Is reagent water aged prior to use? Stored in Incubator

   How long? Approx. 3 days, under what conditions? [illegible]

   [illegible]

Recommendations:

[illegible]

D. Dilution Water

1. Are the four (4) nutrient buffers added to the reagent water?
   Yes

   a. 7.5 mls of each nutrient buffer per 7500 mls of reagent water

2. When is phosphate buffer added (in relation to setting up BOD test)? All Reagents added on the dilution water used

3. How often is dilution water prepared? 4 [illegible] (Twice weekly)
   Maximum age of dilution water at the time test is set up.
   Less Than 1 Day

4. Under what conditions is dilution water kept? [illegible]

5. What is temperature of dilution water at time of setup? [illegible] 20°C

Recommendations:

E. Test Procedure

1. How often are BOD's being set up? Twice a week (Wed & Fri.)

   What is maximum holding time of sample subsequent to end of composite period? 2 to 3 hrs

2. If sample to be tested has been previously frozen, is it reseeded? N/A How?

3. Does sample to be tested contain residual chlorine? Yes
   If yes, is sample

   a. Dechlorinated? Yes

      How? with 14 drops of 0.1 N Thio

   b. Reseeded? ~~[illegible]~~ Yes

      How? 1 ml of primary effluent in 300 ml BOD bottle

4. Is pH of sample between 6.5 and 8.5? Virtually always, except industrial trial samples

   If no, is sample pH adjusted and sample reseeded? No

5. How is pH measured? Beckman Digital pH Meter

   a. Frequency of calibration? Unknown

   b. Buffers used? 4 and 7

   [illegible] temp scale (°C) [illegible]

6. Is final effluent sample toxic? Probably not

7. Is the five (5) day DO depletion of the dilution water (blank) determined? [illegible], normal range? [illegible]

8. What is the range of initial (zero day) DO in dilution water blank? [illegible]

9. How much seed is used in preparing the seeded dilution water? [illegible]

10. Is five (5) day DO depletion of seeded blank determined? Yes
If yes, is five (5) day DO depletion of seeded blank approximately 0.5 mg/l greater than that of the dilution water blank? Yes, approximately

11. Is BOD of seed determined? No

12. Does BOD calculation account for five (5) day DO depletion of

    a. Seeded dilution water? Yes

    How? [illegible] seeded blank subtracted from sample [illegible] 5 day [illegible]

    b. Dilution water blank? Yes, [illegible]

    How? See above

13. In calculating the five (5) day DO depletion of the sample dilution, is the initial (zero day) DO obtained from

    a. Sample dilution? [illegible] dilution, Yes for final

    b. Dilution water blank? Yes, for the other samples

14. How is the BOD₅ calculated for a given sample dilution which has resulted in a five (5) day DO depletion of less than 2.0 ppm or has a residual (final) DO of less than 1.0 ppm? Not usually a problem

15. Is liter dilution method or bottle dilution method utilized in preparation of

    a. Seeded dilution water? No, [illegible]

    b. Sample dilutions? No " " " " "

16. Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? Yes

17. How is incubator temperature regulated? [illegible] [illegible]

[illegible] [illegible] bath

18. Is the incubator temperature gage checked for accuracy?

a. If yes, how?

b. Frequency?

19. Is a log of recorded incubator temperatures maintained? No

a. If yes, how often is the incubator temperature monitored/checked? N/A

20. By what method are dissolved oxygen concentrations determined?

Probe ______ Winkler X ______ Other ______

a. If by probe:

1. What method of calibration is in use? N/A

2. What is the frequency of calibration?

b. If by Winkler:

1. Is sodium thiosulfate or PAO used as titrant? Thio

2. How is standardization of titrant accomplished?

"Occasionally" - Biiodate

3. What is the frequency of standardization?

Recommendations:

1) Routinely check pH of samples ([illegible]) and adjust pH to [illegible] range if necessary. Calibrate pH meter daily as used, temperature indicated in °C.

2) Use water bath incubator [illegible] heater, maintain [illegible] temperature and settings.

3) Standardize thio [illegible]

4) [illegible] samples [illegible]

[illegible]

F. Calculating Final Biochemical Oxygen Demand Values Washington State Department of Ecology

1. Correction Factors

a. Dilution factor:

$$= \frac{\text{total dilution volume (ml)}}{\text{volume of sample diluted (ml)}}$$

b. Seed correction:

$$= \frac{\text{(BOD of Seed)(ml of seed in 1 liter dilution water)}}{1000}$$

c. F factor ~ a minor correction for the amount of seed in the seeded reagent versus the amount of seed in the sample dilution:

$$F = \frac{\text{[total dilution volume (ml)] - [volume of sample diluted ml]}}{\text{Total dilution volume, ml}}$$

2. Final BOD Calculations

a. For seed reagent:

(seed reagent depletion-dilution water blank depletion) x D.F.

b. For seeded sample:

(sample dilution depletion-dilution water blank depletion-scf) x D.F.

c. For unseeded sample:

(sample dilution depletion-dilution water blank depletion) x D.F.

3. Industry/Municipality Final Calculations

1) All But Final: $(D.O._0 - D.O._5)f$

of sample dilution

of dilution water (problem)

2) Final: $[(DO_0 - DO_5) - (DO_0 - DO_5)]f$

of sample dilution / of seeded blank

Recommendations:

[illegible]

III. TOTAL SUSPENDED SOLIDS CHECKLIST

A. Technique

1. What analysis technique is utilized in determining total suspended solids?

   a. Standard Methods? x Edition 13th

   b. EPA? ________

   c. A.S.T.M.? ________

   d. Other (specify)? ________

B. Test Procedure

1. What type of filter paper is utilized:

   a. Reeve Angel 934 AH? ________

   b. Gelman A/E? ________

   c. Other (specify)? Millipore - HAWG 0.45 (47mm)

   d. Size? ________

2. What type of filtering apparatus is used? Millipore

3. Are filter papers prewashed prior to analysis? Yes

   a. If yes, are filters then dried for a minimum of one hour overnight at 103°C-105°C Yes ?

   b. Are filters allowed to cool in a dessicator prior to weighing? Yes

4. How are filters stored prior to use? [illegible]

5. What is the average and minimum volume filtered? [illegible]

6. How is sample volume selected?

   a. Ease of filtration? [illegible]

   b. Ease of calculation?

   c. Grams per unit surface area?

   d. Other (specify)?

7. What is the average filtering time (assume sample is from final effluent)? [illegible]

8. How does analyst proceed with the test when the filter clogs at partial filtration? Start over.

9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? [illegible]

10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample? Yes.

11. Is filter funnel washed down following sample filtration? Yes

12. Following filtration, is filter dryed for one (1) hour, cooled in a desscator, and then reweighed? Yes, [illegible]

13. Subsequent to initial reweighing of the filter, is the drying cycle repeated until a constant filter weight is obtained or until weight loss is less than 0.5 mg? [illegible]

14. Is a filter aid such as cellite used? /

a. If yes, explain:

Recommendations:

1) CONVERT TO APPROVED FILTERS AS SOON AS POSSIBLE

C. Calculating Total Suspended Solids Values Washington State Department of Ecology

A. $\text{mg/l TSS} = \frac{A-B}{C} \times 10^6$

1. Where: A = final weight of filter and residue (grams)

B = initial weight of filter (grams)

C = Milliliters of sample filtered

2. Industry/Municipality Calculations

$(A-B)(10{,}000)$ for 100 ml samples

$(A-B)(20{,}000)$ for 50 ml samples

Recommendations:

SPLIT SAMPLE RESULTS:

Origin of Sample

Collection Date

BOD		TSS		EPA BOD Standard	
[illegible] ~~DOE~~	DOE ~~IND./MUN.~~	DOE	IND./MUN.	DOE	IND./MUN
90	88				
61	82				
17	18				
19	12				